UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/778,009	02/11/2004	Erik C. Scher	40-001330US	3323

22798 7590 09/12/2008

QUINE INTELLECTUAL PROPERTY LAW GROUP, P.C.
P O BOX 458
ALAMEDA, CA 94501

EXAMINER	
TRINH, THANH TRUC	
ART UNIT	PAPER NUMBER
1795	
MAIL DATE	DELIVERY MODE
09/12/2008	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/778,009	SCHER ET AL.	
	Examiner	Art Unit	
	THANH-TRUC TRINH	1795	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *02 July 2008*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *104-111,113-140 and 286* is/are pending in the application.

4a) Of the above claim(s) *286* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *104-111,113-140 and 286* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Election/Restrictions

1. This application contains claims directed to the following patentably distinct species:

A: A photovoltaic device having a photoactive layer comprises a fist population of discrete nanostructures and a small molecule, which small molecule is other than dye, and wherein the photoactive layer is free of conductive polymer. (Claims 104-111 and 113-140)

B: A photovoltaic device having a photoactive layer comprises a first population of nanostructures and a conductive polymer whose charge carrying properties have been altered during fabrication of the device by controlled partial oxidation of the polymer. (Claim 286)

The species are independent or distinct because claims to the different species recite the mutually exclusive characteristics of such species. In addition, these species are not obvious variants of each other based on the current record.

Applicant is required under 35 U.S.C 121 to elect a single disclosed species for prosecution on the merits to which the claims shall be restricted if no generic claim is finally held to be allowable. Currently, no claim is generic.

There is an examination and search burden for these patentably distinct species due to their mutually exclusive characteristics. The species require a different field of search (e.g., searching different classes/subclasses or electronic resources, or employing different search queries); and/or the prior art applicable to one species would

not likely be applicable to another species; and/or the species are likely to raise different non-prior art issues under 35 U.S.C. 101 and/or 35 U.S.C. 112, first paragraph.

Applicant is advised that the reply to this requirement to be complete must include (i) an election of a species to be examined even though the requirement may be traversed (37 CFR 1.143) **and (ii) identification of the claims encompassing the elected species**, including any claims subsequently added. An argument that a claim is allowable or that all claims are generic is considered nonresponsive unless accompanied by an election.

The election of the species may be made with or without traverse. To preserve a right to petition, the election must be made with traverse. If the reply does not distinctly and specifically point out supposed errors in the election of species requirement, the election shall be treated as an election without traverse. Traversal must be presented at the time of election in order to be considered timely. Failure to timely traverse the requirement will result in the loss of right to petition under 37 CFR 1.144. If claims are added after the election, applicant must indicate which of these claims are readable on the elected species.

Should applicant traverse on the ground that the species are not patentably distinct, applicant should submit evidence or identify such evidence now of record showing the species to be obvious variants or clearly admit on the record that this is the case. In either instance, if the examiner finds one of the species unpatentable over the prior art, the evidence or admission may be used in a rejection under 35 U.S.C. 103(a) of the other species.

Upon the allowance of a generic claim, applicant will be entitled to consideration of claims to additional species which depend from or otherwise require all the limitations of an allowable generic claim as provided by 37 CFR 1.141.

During a telephone conversation with Applicant's representative on 27 August 2008, a provisional election was made without traverse to prosecute the invention of Group A, claims 104-111 and 113-140. Affirmation of this election must be made by applicant in replying to this Office Action. Claim 286 is withdrawn from further consideration by the examiner, 37 CFR 1.142(b) as being drawn to a non-elected invention.

Priority

2. The later-filed application must be an application for a patent for an invention which is also disclosed in the prior application (the parent or original nonprovisional application or provisional application). The disclosure of the invention in the parent application and in the later-filed application must be sufficient to comply with the requirements of the first paragraph of 35 U.S.C. 112. See *Transco Products, Inc. v. Performance Contracting, Inc.*, 38 F.3d 551, 32 USPQ2d 1077 (Fed. Cir. 1994).

The disclosure of the prior-filed application, Application Nos. 10/656802, 60/452038, 60/421353 fail to provide adequate support or enablement in the manner provided by the first paragraph of 35 U.S.C. 112 for one or more claims of this application.

.Applications Nos. 10/656802, 60/452038, 60/421353 do not contain subject matter such as "the photoactive layer comprises a first population of discrete nanostructures and a small molecule, which small molecule is other than a dye, and wherein the photoactive layer is free of conductive polymer", and limitations described in claims 139-140.

Information Disclosure Statement

Applicant requests that the Examiner indicates consideration of the citations of two Information Disclosure Statements dated July 14, 2004 and July 23, 2004. However, there are no such Information Disclosure Statements submitted for the Examiner to consider. All submitted IDS has been considered.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

3. Claims 104-110, 113-120, 123, 125-129, 134-136 are rejected under 35 U.S.C. 102(e) as being anticipated by Den et al. (US Patent 6649824).

Regarding claims 104-108, as seen in Figures 1, 4-6, Den teaches a photovoltaic device comprising a first electrode layer (or the electrode of electrode bearing substrate 10 as seen in Figure 1A, 1C; or 42 as seen in Figure 4A, 4C; or 15a as seen in Figure 6); a second electrode layer (or the electrode of electrode bearing substrate 13, 15b as seen in Figure 6); a first photoactive layer (including 11b and 12 as seen in Figures 1A, 1C; or layer containing semiconductor crystals 17 and charge transfer 12 as seen in Figures 4A-4D and 5A-D) disposed between the first and second electrode layers, wherein the photoactive layer is disposed in contact with the first electrode and with the second electrode. The photoactive layer comprises a first population of discrete nanostructures (semiconductor crystal 17 as seen in Figures 4A-D and 5A-D, also see Examples 1-13) and a small molecule (such as tetrapropylammonium iodide of the charge transfer layer – See Examples 1, 7, 9, 11 and 13), which small molecule is other than a dye, and wherein the photoactive layer is free of conductive polymer.

Regarding claims 105-108, Den et al. teaches the nanostructures (17) are used as electron acceptor and the charge transfer layer (12) with iodide of tetrapropylammonium iodide is used as electron donator (or conducting holes) in a photovoltaic device (See abstract and col. 3 lines 3-21) . Therefore the nanostructures (such as n-type semiconductor crystals) and the small molecule (tetrapropylammonium iodide) exhibit a type II band offset energy profile. Tetrapropylammonium iodide inherently is a nonpolymer molecule and has molecular weight of less than 3000, less than 1500, less than 1000, or less than 500.

Regarding claim 109, Den et al. teaches the nanostructures (17) are disposed in a matrix (12) which comprises the small molecule (such as tetrapropylammonium iodide). (See Figures 1, 4-6, col. and Examples 1-13)

Regarding claim 110, Den et al. teaches the photoactive layer comprises at least two sublayers (11 and 12 as seen in Figures 1A and 1C), wherein at least one of the sublayers (11) comprises the nanostructures (17- See col. 6 lines 26-40) and at least one of the sublayers (e.g. layer 12) comprises the small molecule (See Examples 1-13).

Regarding claim 113, Den et al. teaches the nanostructures comprise nanocrystals. (See col. 6 lines 26-49, Examples 1-13)

Regarding claim 114, Den et al. teaches the nanostructures (17) comprise nanowires. (See Figures 4A-D, 5A-D)

Regarding claims 115-117, Den et al. teaches using amorphous semiconductor (See col. 10 lines 60-65), and the use of single crystal semiconductor such as CdSe is well known in solar cell (See col. 1 lines 49-55)

Regarding claim 118, Den et al. teaches the photoactive layer (including layer 11 and 12) is disposed in at least partial electrical contact with the first electrode along a first plane and with the second electrode along a second plane. (See Figures 1, 4-6)

Regarding claim 119, Den et al. teaches the nanostructures (17) of the first population each has at least one elongated section oriented predominantly normal to at least the first plane. (See Figures 4A-D, 5A-D)

Regarding claim 120, Den et al. teaches the nanostructures (17) comprise branched nanocrystals having more than one elongated segment. (See Figures 8A-C)

Regarding claim 123, Den et al. teaches forming "films" of electrodes (e.g. F-doped SnO_2 as seen in Example 1). An electrode film is inherently flexible.

Regarding claim 125, Den et al. teaches at least one of the first and second electrodes comprises a transparent conductive layer. (See col. 12 lines 4-12)

Regarding claim 126, Den et al. teaches at least one of the electrodes comprises aluminum. (See col. 12 lines 13-16)

Regarding claims 127-129, Den et al. teaches the photoactive layer (11 and 12) is sandwiched between two electrode bearing substrates 10 and 13. Den et al. also teaches sealing the device (See col. 12 lines 35-46). Therefore, Den et al. teaches the photovoltaic layer is hermetically sealed.

Regarding claims 134-135, Den et al. teaches the first population of nanostructures comprises at least two different nanocrystal subpopulations (17 and 18 as seen in Figures 4C-D, 5C-D, 9B). Den et al. teaches the crystals 18 comprise different type of semiconductor crystals than that of the crystals 17 (See col. 10 lines 45-57), therefore Den et al. teaches each nanocrystal subpopulation having a different absorption spectrum and different composition (because each nanocrystal subpopulation comprises different type of semiconductor crystals).

Regarding claim 136, Den et al. teaches the different nanocrystal subpopulations (17 and 18) comprise nanocrystals having different size distributions (See Figures 4C-4D, 5C-5D, 9B).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

4. Claims 111 and 124 are rejected under 35 U.S.C. 103(a) as being unpatentable over Den et al. (US Patent 6649824) in view of Wariishi et al. (US Patent 6376765).

Den et al. teaches a photovoltaic device as applied to claims 104-110, 113-120, 123, 125-129, 134-136 above.

Den et al. does not teach the small molecule is dispersed in a non-conductive polymer. Den et al. teaches the electrodes are flexible as seen in the explanation in claim 123 above. Den et al. also teaches the thickness of the semiconductor layer (11) is about 10 μm and the charge transfer layer (12) is added dropwise (See Example 1), but does not teach the photoactive layer (11 and 12) is flexible.

With respect to claim 111, Wariishi et al. teaches an electrolyte composition (or charge transfer layer) comprising the small molecule (tetrapropylammonium iodide as seen in formula Y-b, col. 57-67), wherein the electrolyte composition can be gelled by

adding polymer such as polyacrylonitrile. Polyacrylonitrile is known as a non-conductor (See claim 3 of supporting reference, US Patent 3666552). Therefore it is the Examiner's position that Wariishi et al. teaches the small molecule (tetrapropylammonium iodide) is dispersed in a nonconductive polymer (e.g. polyacrylonitrile).

With respect to claim 124, Wariishi et al. teaches the charge transfer layer (or charge-transporting layer has a thickness preferably from 0.1 to 50 μm, and the total thickness of the photoactive layer is preferably 2 to 75 μm. (See col. 55 lines 35-50). It is the Examiner's position that a photoactive layer is flexible when having a thickness of 2 to 75 μm.

It would have been obvious to one skilled in the art at the time the invention was made to modify the charge transfer layer of Den et al. by dispersing the small molecule (or tetrapropylammonium iodide) in a non-conductive polymer (e.g. polyacrylonitrile) as taught by Wariishi et al., because Wariishi et al. teaches that it would be a practical use to gel the electrolyte composition (or charge transfer) by adding polymer (See col. 19 lines 53-58). It would also have been obvious to have a flexible photoactive layer (or thin photoactive layer) as taught by Wariishi et al., because Wariishi et al. teaches the photoactive layer comprising the semiconductor layer and the charge transfer layer (or charge transport layer) have to be thin enough to avoid short circuit (or the semiconductor come in contact with the counter electrically conductive layer) and to transfer charge efficiently (or not to increase the resistance in the device - See col. 55 lines 35-50 of Wariishi et al.)

5. Claim 121-122 and 130-133 are rejected under 35 U.S.C. 103(a) as being unpatentable over Den et al. (US Patent 6649824) in view of Sager et al. (US Patent 6946597).

Den et al. teaches a photovoltaic device as applied to claims 104-110, 113-120, 125-129, 134-136 above.

Den et al. does not teach a hole blocking layer disposed between the photovoltaic layer and the first electrode and an electron blocking layer disposed between the photoactive layer and the second electrode. Den et al.

Sager et al. teaches a hole blocking layer (108) disposed between the photovoltaic layer (101) and the first electrode (110) and an electron blocking layer (104) disposed between the photoactive layer (101) and the second electrode (106). Sager et al. describes layer (108) of metal attaching to electrode 110 (See Figure 1A and col. 8 lines 20-25). Therefore it is the Examiner's position that layer 108 conducts electrons and can function as a hole blocking layer.

It would have been obvious to one skilled in the art at the time the invention was made to modify the photovoltaic device of Den et al. by incorporating the electron blocking layer and the hole blocking layer as taught by Sager et al. because Sager et al. teaches such layers can function as barrier layers (e.g. blocking layers) (See col. 7 lines 55-67)

Regarding claims 130-133, Den et al. in view of Wariishi et al. teaches a flexible photoactive layer. It would have been obvious to one skilled in the art at the time the

invention was made to have a non-planar architecture device, a convex architecture and a coiled architecture. It would certainly have been obvious to one having ordinary skill in the art at the time the invention was made to have the first electrode, the photoactive layer and the second electrode layer oriented in a reciprocating stacked architecture, because there is nothing unobvious about rearranging the photovoltaic device to receive light from the sides, or left and right instead from the top.

6. Claims 137-138 are rejected under 35 U.S.C. 103(a) as being unpatentable over Den et al. (US Patent 6649824) in view of Salafsky (US Patent 6239355).

Den et al. teaches a photovoltaic device as applied to claims 104-110, 113-120, 123, 125-129, 134-136 above.

Den et al. does not teach a second photoactive layer, a third electrode, a fourth electrode, wherein the second photoactive disposed between the third and fourth electrode.

Salafsky teaches a second photoactive layer (308 besides the first photoactive layer 106 as seen in Figure 3), a third electrode (306 and 307), a fourth electrode (310 and 312), wherein the second photoactive layer 308 is disposed in at least partial electrical contact with the third electrode (306 and 307) along a third plane and in at least partial electrical contact with the fourth electrode (310 and 312) along a fourth plane. The second photoactive layer comprises a second population of nanostructure having a different absorption spectrum from the first population of nanostructures (See col. 5 line 57 to col. 6 line 4 of Salafsky), and wherein the third and fourth electrodes

and the second photoactive layer are attached to the first and second electrodes and the first photoactive layer via an isolation layer (304 – See col. 5 line 26 to col. 6 line 4).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the photovoltaic device of Den et al. by including a third electrode, a fourth electrode and a second photoactive layer as taught by Salfsky because it would provide a device that is responsive to light in more than one spectral band (See col. 2 lines 54-60 of Salafsky)

7. Claims 139-140 are rejected under 35 U.S.C. 103(a) as being unpatentable over Den et al. (US Patent 6649824) in view of Bulovic et al. (US Patent 6198092)

Den et al. teaches a photovoltaic device as applied to claims 104-110, 113-120, 123, 125-129, 134-136 above, wherein Den et al. teaches the photoactive layer (11 and 12) comprising electron acceptive charge transfer layer and electron donative charge transfer layer as seen in the Abstract.

Den et al. does not teach a third electrode layer and a second photoactive layer disposed between the second and third electrodes layer, wherein the second photoactive layer is disposed in at least partial electrical contact with the second electrode and in at least partial electrical contact with the third electrode. Nor does he teach a second photoactive layer, and a first recombination material disposed between the first and second photoactive layer, wherein the first recombination material is in at least partial contact with the first and second photoactive layers.

Bulovic et al. teaches stacking photoactive layers in series as seen in Figure 8C; wherein the stack photovoltaic device comprises a first electrode (802a), a second

electrode (805a), a third electrode (802b), a first photoactive layer (803a and 804a), a second photoactive layer (803b and 804b) disposed in at least partial electrical contact with the second electrode (805a) and in at least partial contact with the third electrode (802b). It is the Examiner's position that the second electrode (805a) is a first recombination material disposed between the first and second photoactive layers since the photoactive layers connected in series.

It would have been obvious to one skilled in the art at the time the invention was made to modify the device of Den et al. by stacking the photoactive layers in series as taught by Bulovic et al., because Bulovic et al. teaches stacked series connected solar cells are suitable for providing a required voltage (See col. 14 lines 1-6 of Bulovic et al.)

Response to Arguments

Applicant's arguments with respect to claims 104-111 and 113-140 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to THANH-TRUC TRINH whose telephone number is (571) 272-6594. The examiner can normally be reached on 4/10.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, NAM NGUYEN can be reached on 571-272-1342. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Nam X Nguyen/
Supervisory Patent Examiner, Art Unit 1753

TT
8/28/2008

/Alex Noguerola/

Primary Examiner, Art Unit 1795

September 2, 2008